Water Quality Of Two Ponds In Waghodiya Taluka, Vadodara District

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Abstract

Wetland is one of the most important ecosystems of the world. They have great potential for biomass production and capable for harvesting rich and diverse flora and fauna. The urbanization, industrialization and other developments lead to change in water quality of ponds. The present study was carried out to analyze the physicochemical parameters, of two ponds of Vadodara district of Gujarat state for a period of one year to know the quality of pond. All the parameters are within the permissible limits prescribed by Indian standards, however the hardness values for Alwa pond slightly higher than the prescribed limits. The sulphates values were reported higher in summer 287.73 mg/l at Limda and 172.08 mg/l at Alwa Pond. The major contributors of the decline in water quality of ponds reveal discharge of untreated domestic waste. The paper highlights the temporal changes observed in important parameters and their relation in overall ecology of the pond. The paper suggest strategies for conservation of ponds in near future.

Keywords: Wetlands, Physico-Chemical Parameters, Flouride, Sulphate.

Introduction

All the organisms need water for their life activities. Most of fresh water is present in rivers, ponds, lakes and wells. Wetlands are transitional area between the riverine and terrestrial systems. These wetlands supporting great diversity of organisms are known as the second most productive zone in the world[1]. Dependence of organism on a wetland or water body is based on its physical and chemical properties. In other words, these properties are also reflected through the diverse variety of flora and fauna supported by it.

Water bodies exhibit a wide range of ecological, social and aesthetic values[2]. The quality of water in a water body is not only essential for the human being but also for the survival of flora and fauna supported by it[3]. The properties of freshwater bodies are the characteristics of the climatic, geochemical, geomorphological and pollution conditions prevailing in the drainage basin and the underlying aquifer[1]. These characteristics with natural or manmade changes determine the quality of water[4]. The influence of human utilization or dependency on urban water resources could not be ignored. Further, high amount of nutrients were also loaded into water bodies from human settlements via sewage [5].

Waghodiya taluka lies on the eastern boundary of Vadodara district categorized with semi-arid conditions. Wetlands are important source of water not only for recharge of ground water, but also for various activities like washing clothes, cattle bathing and others. In the era of industralisation and urbanization the area has come under development pressure and the present study was undertaken to assess the status of the ponds with respect to water quality. It is proved that seasonal changes water quality is well pronounced in the semi arid zone coupled with human pressures [6].

Materials and Method

Two ponds Alwa and Limda were selected for the present study (Fig 1). Alwa pond has an area of 2.6 Ha with monsoonal expanse of 4.5 ha. The depth of the pond is 3 m with storage capacity of 26000 cubic m. On the other hand Limda pond has an area of 1 ha with monsoonal expanse of 2 to 2.5 ha. The pond though small sustains marginal fishing apart from cattle bathing and washing clothes.

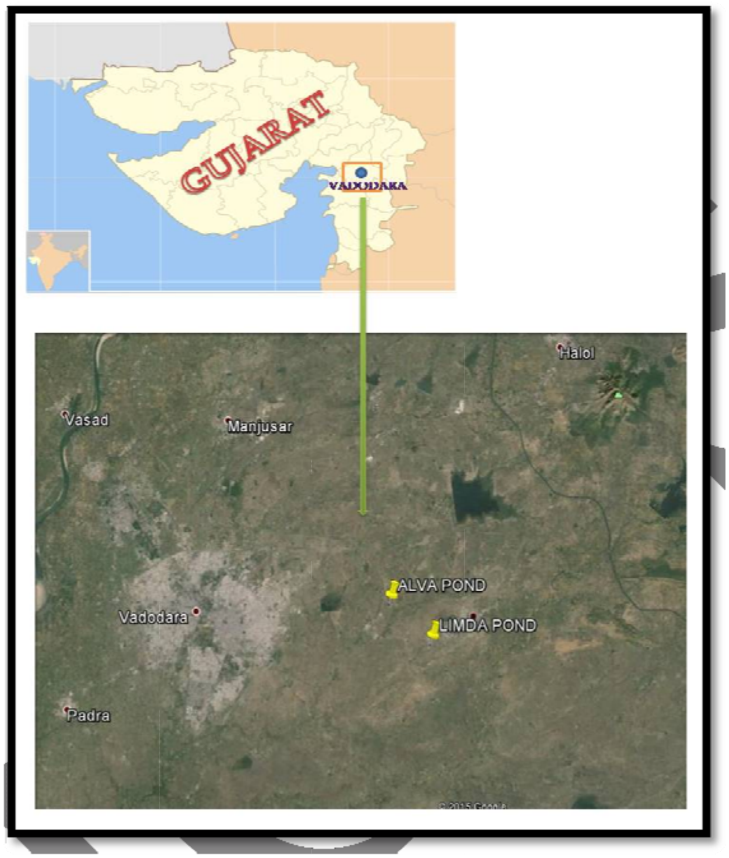

Figure 1: Location map of study area

Seasonal water samples were collected from each Ponds, Alwa and Limda for one year. The standard methods mentioned in the APHA were used for sample collection. Temperature, pH and conductivity were measured directly at the site using instruments. The Dissolved oxygen was fixed at the site. Chemical Oxygen Demand (COD) was estimated by volumetric titration with standard Ferrous Ammonium Sulphate using Ferroin as indicator. Total Hardness was estimated by complexometric titration (EDTA method) using Eriocrome Black-T as an indicator. Chloride was determined by Mohr's method using $AgNO_3$ solution and Potassium Chromate as an indicator. Total phosphate and Phosphate phosphorus were estimated by Ascorbic acid method. Nitrites (NO_2-N) were estimated by Colorimetric method and Nitrates were estimated by Cadmium reduction method. Sulphates were estimated by Tubidimetric method.

Results and Discussion

The average water temperature in Limda pond was 29.58 ± 1.84 °C and in Alwa pond was 30.53 ± 1.12 °C. The higher water temperature throughout the year is related to the higher atmospheric temperature 32.75 ±1.34 °C in both the ponds. pH of the pond indicated slightly alkaline nature with values of 8.22 ± 0.25 and 7.67 ± 0.27 for Limda and Alwa ponds respectively. The water of both these ponds is used for washing clothes, cattle bathing, domestic sewage discharge, etc. which might have led to increase in pH of water.

Total Dissolved Solids (TDS) is one of the important criteria for determining the quality of water. In present study, the TDS values were reported as 476 ± 217.23 and 539.11 ± 209.3 mg/l for Limda and Alwa ponds respectively. Seasonal fluctuation of TDS values was responsible for higher variation observed in both the ponds. During summers due to shrinkage of pond and reduction in water quantum higher TDS was recorded as compared to other seasons. The Total Suspended Solids (TSS) values include all particles suspended in water which will not pass through a filter paper. In this study, the average TSS values were recorded to be 113.25 ± 15.16 and 123.06 ± 28.67 mg/l respectively for Limda and Alwa ponds respectively. The Indian Standard prescribed for TSS is 100mg/l. However, the TSS values for both ponds in this study are slightly higher than the prescribed limits which may be due to discharge of untreated sewage in the pond water. Water with high suspended solids is unsatisfactory for bathing, industrial and other purpose[7].

The average DO level for Limda pond was 3.40 ± 0.73 mg/l and for Alwa pond was 2.55 ± 0.88 mg/l. The Indian standard prescribed for DO values for survival of various aquatic species range from 6 mg/l in warm water to 9.5 mg/l in cold water. As compared to these, the two ponds in this study have very low DO. Input of domestic sewage into both the ponds that require more oxygen for degradation could be one of the reasons for low DO. Further, in Alwa pond there is overgrowth of water lily that cuts off atmospheric oxygen resulting in anaerobic condition and depletion of oxygen.

The Biological Oxygen Demand BOD values recorded was very low and below 1.5 mg/l indicative of higher demand of oxygen for oxidative degradation. The similar results reported at pond of Ayodhya- Faizabad[8]. Chemical Oxygen Demand (COD) is used to measure the level of chemical oxidative stress in the water. In the present study COD values for Limda and Alwa pond recorded was 13.33 ± 18.46 mg/l and 6.67 ± 6.11 mg/l respectively. The COD/BOD ratio in the present study was more than 2 in both the ponds indicative of presence of untreated sewage waste. The similar results also reported for Okhla Bird Sanctuary[9].

The average Chloride level for Limda was 0.04 ± 0.01 mg/l and for Alwa pond was 0.030 ± 0.01 mg/l. The levels were within the limits prescribed for fresh water. In both the ponds the chlorides levels increased from monsoons to summers indicative of shrinkage in pond.

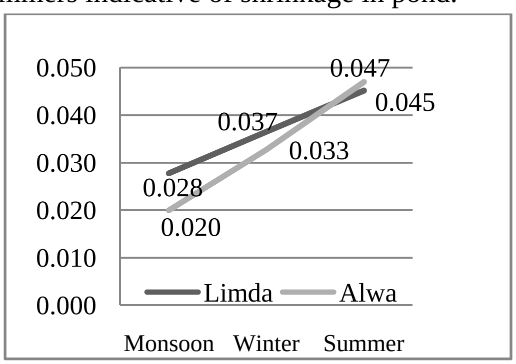

Figure 2 Seasonal Comparison of Chloride in both ponds

The values of Total hardness recorded were 114.83 ± 21.22 mg/l and 184.28 ± 39.91mg/l for Limda and Alwa respectively. The values indicate hard water, which may be due to high sulphates at both the ponds. The average Sulphate value at Limda pond was 97.24 ± 164.97 mg/l and in Alwa pond was

58.28 ± 98.56 mg/l. There is strong seasonal fluctuation in the sulphate levels of the ponds and an increment of 100 times was reported in summers in both the ponds (fig.3). The unusual higher sulphate in the summers is due to dissolution of sulphates from the pond bed due to high temperatures. The presence of sulphate and phosphate in pond water may be responsible for high alkalinity as well as total hardness[10].

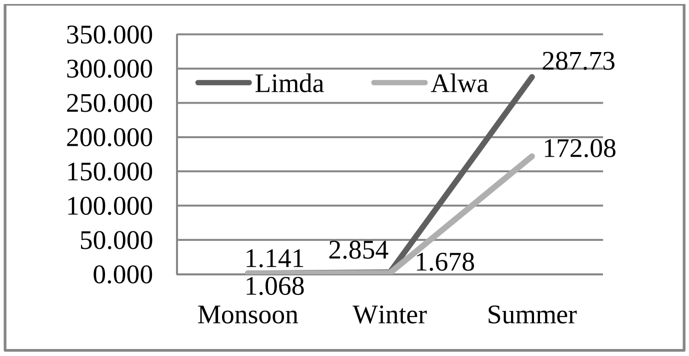

Figure 3: Seasonal variation of sulphates (mg/l) in Alwa and Limda pond

With regards to nutrient status values of nitrate, nitrite and total nitrogen were within the limits in both the ponds (Table 1). The average total phosphate and Phosphate- phosphorus levels were similar at both the ponds. Similar results were obtained for River Vishwamitri[11]. The values of Total nitrogen (0.508 mg/l) and Total phosphate (0.215 mg/l) was recorded maximum in summer at Limda pond. Similarly, the values of Total nitrogen (0.566 mg/l) and Total phosphate (0.199 mg/l) was also recorded maximum at summer in Alwa pond. Seasonal fluctuation of the parameters was significant in both the ponds and values increased from monsoon to summers. The shrinkage of the ponds and concentration of nutrients is the major reason for the higher values during summers.

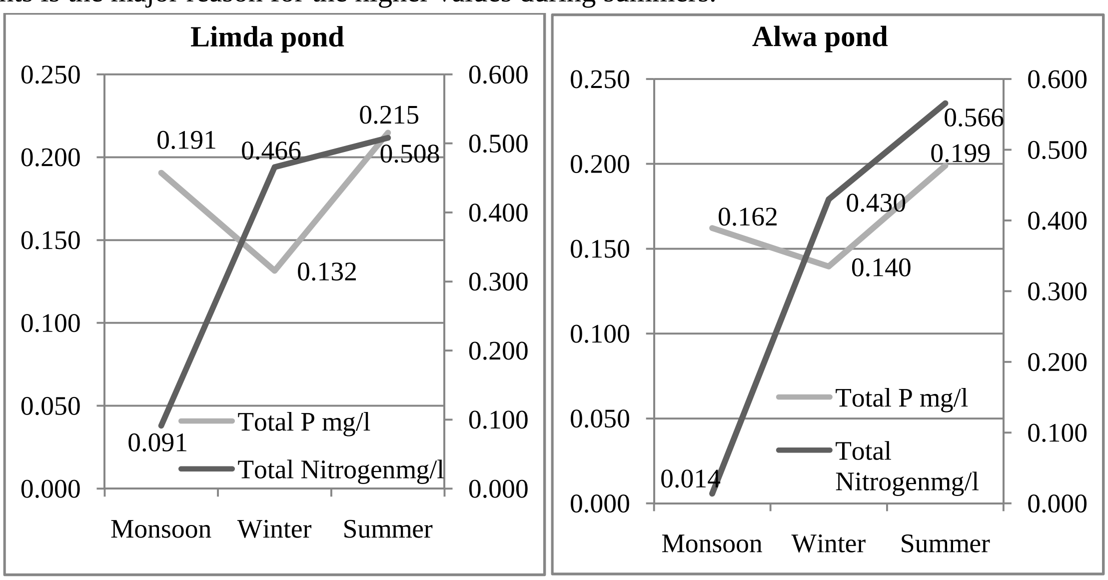

Figure 4. Seasonal Comparison of Total phosphate and Total nitrogen in both ponds

In present study Fluoride level at Limda pond was 0.71 ± 0.37 mg/l and at Alwa pond was 0.85 ± 0.48mg/l. Generally Flouride content is 0.5 mg/l minimum value beyond that it causes pollution to the water [12].Thus in both the ponds the fluoride levels is high compared to the prescribed limits.

Table 1 Result of water quality Parameters

Study areas	Limda		Alwa	
Parameters	Mean	Std. Deviation	Mean	Std. Deviation
Water Temperature	29.58	1.84	30.53	1.12
Air Temperature	32.75	0.87	33.39	1.34
pH	8.22	0.25	7.67	0.27
TDS mg/L	476	217.23	539.11	209.3
TSS mg/l	113.25	15.16	123.06	28.67
DO mg/l	3.4	0.73	2.55	0.88
BOD mg/l	1.1	1.68	0.2	0.35
Chlorinity mg/l	0.04	0.01	0.03	0.01
Total Hardness mg/l	114.83	21.22	184.28	39.91
NO_3-N mg/l	0.07	0.05	0.04	0.02
Total Nitrogen mg/l	0.36	0.23	0.34	0.29
NO_2-N mg/l	0.06	0.08	0.02	0.01
PO4-P mg/l	0.09	0.02	0.1	0.02
Total P mg/l	0.18	0.04	0.17	0.03
Sulphates mg/l	97.24	164.97	58.28	98.56
Flourides mg/l	0.71	0.37	0.85	0.48
COD mg/l	13.33	18.46	6.67	6.11

Table 2.Correlation between water quality parameters of Limda pond

Parameters	Water Temperature	Air Temperature	pH	TDS	TSS	DO	BOD	Cl	TH	NO3N	TN	NO2N	PO4P	TP	Sulphate	Flouride	COD
Water Temperature	**1**																
Air Temperature	**.666**	**1**															
pH	**-.459**	**.358**	**1**														
TDS	**.967**	**.454**	**-.669**	**1**													
TSS	**-.313**	**.500**	**.988**	**-.544**	**1**												
DO	**.170**	**.848**	**.798**	**-.086**	**.883**	**1**											
BOD	**-.992**	**-.565**	**.569**	**-.992**	**.432**	**-.042**	**1**										
Cl	**.170**	**.849**	**.798**	**-.086**	**.882**	**1.00****	**-.043**	**1**									
TH	**-.199**	**.599**	**.962**	**-.442**	**.993**	**.932**	**.323**	**.932**	**1**								
NO3N	**.372**	**-.445**	**-.995**	**.596**	**-.998***	**-.852**	**-.488**	**-.851**	**-.984**	**1**							
TN	**-.225**	**.577**	**.969**	**-.465**	**.996**	**.922**	**.348**	**.922**	**1.000***	**-.988**	**1**						
NO2N	**.307**	**-.505**	**-.987**	**.539**	**-1.00****	**-.886**	**-.427**	**-.885**	**-.994**	**.998***	**-.996**	**1**					
PO4P	**.845**	**.962**	**.088**	**.681**	**.243**	**.671**	**-.769**	**.671**	**.356**	**-.182**	**.331**	**-.249**	**1**				
TP	**.997**	**.723**	**-.386**	**.944**	**-.237**	**.248**	**-.978**	**.248**	**-.120**	**.297**	**-.147**	**.231**	**.885**	**1**			
Sulphate	**.662**	**1.00****	**.362**	**.450**	**.504**	**.851**	**-.561**	**.851**	**.603**	**-.450**	**.581**	**-.510**	**.960**	**.720**	**1**		
Fluoride	**-.988**	**-.545**	**.588**	**-.995**	**.453**	**-.019**	**1.00***	**-.019**	**.345**	**-.508**	**.370**	**-.448**	**-.754**	**-.973**	**-.541**	**1**	
COD	**-.937**	**-.363**	**.741**	**-.995**	**.626**	**.186**	**.974**	**.185**	**.529**	**-.673**	**.552**	**-.621**	**-.604**	**-.906**	**-.358**	**.979**	**1**

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 3. Correlation between water quality parameters of Alwa pond

Parameters	**Water Temperature**	**Air Temperature**	**pH**	**TDS**	**TSS**	**DO**	**BOD**	**Cl**	**TH**	**NO3N**	**TN**	**NO2N**	**PO4P**	**TP**	**Sulphate**	**Flouride**	**COD**
Water Temperature	**1**																
Air Temperature	**.955**	**1**															
pH	**.162**	**.448**	**1**														
TDS	**.976**	**.868**	**-.055**	**1**													
TSS	**-.937**	**-.998***	**-.497**	**-.839**	**1**												
DO	**-.247**	**.053**	**.916**	**-.450**	**-.108**	**1**											
BOD	**-.989**	**-.900**	**-.013**	**-.998***	**.874**	**.388**	**1**										
Cl	**.170**	**.456**	**1.000****	**-.047**	**-.504**	**.913**	**-.021**	**1**									
TH	**-.942**	**-.799**	**.179**	**-.992**	**.765**	**.558**	**.981**	**.171**	**1**								
NO3N	**.041**	**.336**	**.993**	**-.176**	**-.388**	**.958**	**.109**	**.992**	**.298**	**1**							
TN	**-.135**	**.166**	**.956**	**-.346**	**-.220**	**.994**	**.281**	**.953**	**.460**	**.985**	**1**						
NO2N	**-.976**	**-.996**	**-.371**	**-.906**	**.990**	**.031**	**.933**	**-.379**	**.847**	**-.256**	**-.082**	**1**					
PO4P	**.937**	**.999**	**.495**	**.840**	**-1.000****	**.106**	**-.875**	**.502**	**-.766**	**.386**	**.218**	**-.991**	**1**				
TP	**.868**	**.976**	**.631**	**.740**	**-.987**	**.267**	**-.784**	**.637**	**-.650**	**.532**	**.375**	**-.955**	**.987**	**1**			
Sulphate	**.621**	**.826**	**.874**	**.437**	**-.856**	**.607**	**-.497**	**.878**	**-.321**	**.808**	**.693**	**-.776**	**.855**	**.928**	**1**		
Fluoride	**-.980**	**-.877**	**.036**	**-1.000***	**.850**	**.433**	**.999**	**.028**	**.990**	**.157**	**.328**	**.915**	**-.850**	**-.753**	**-.454**	**1**	
COD	**-.650**	**-.394**	**.645**	**-.799**	**.343**	**.897**	**.756**	**.638**	**.868**	**.733**	**.841**	**.470**	**-.345**	**-.187**	**.192**	**.787**	**1**

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Pearson's correlation was performed to understand the correlation between all physico-chemical parameters. Some of the important observations recorded include positive correlation between DO and chlorine in Limda pond. Researchers suggest that free floating planktonic organism is sensitive to chlorides and these animals are a food source for fish and amphibians that help control algae that contribute to eutrophication. In the present study also due to eutrophic condition there is decline in DO and thus infers the positive correlation found. A very strong positive relation between total hardness and total nitrogen was reported at Limda pond. This is due to increase in values of both the parameters during summers, when there is shrinkage of pond and nutrient concentration.

In case of Alwa pond negative correlation was found between BOD and TDS. BOD tests only measures biodegradable fraction of the total potential DO consumption of a water sample and TDS indicates presence of suspended solids. In case of Alwa TDS is high due to presence of algae and therefore the relation was observed[13]. Negative relation was found between phosphates and TSS. This indicates that phosphates did not influence the TSS level. TSS could be due to discharge of domestic sewage and little relation was found with total hardness.

In present study untreated sewage is discharged in pond shows high amount of Sulphate. Sulphate is an important constituent of organic waste along with other elements like carbon, oxygen, hydrogen and nitrogen [14].

Conclusion:

The present study of two ponds in the semi-arid zone of Vadodara clearly indicates influence of season on the water quality. There is high stress reported in the ponds during the summers, when there is shrinkage of the pond due to high evaporation rate. The system then recovers during monsoon but the continuous input of sewage and other organic substances in form of cattle washing deteriorate the water quality and worst situation is observed in summers. Incidentally there is pressure on the ponds during summers, when the availability of water worsen the situation. Thus there is need to take long term measures to ensure availability of the water round the year with proper catchment area treatment.

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